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OCCURS	TERM
1	J58085179/PN
2	J61135335/PN
1	J52032542/PN
0	J50002130/PN
1	J56026271/PN
2	J59028678/PN
2	J02170372/PN
0	JJ03163375/PN
2	J63208773/PN
1	J56024678/PN
2	J57088679/PN
2	J57210578/PN
2	J04308429/PN
2	J61081139/PN

SS 2 RESULT (20)
WPAT(8) JAPIO(12)

SS 3?

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Japanese patents & applns. referenced in spec.

-1- (WPAT)

ACCESSION NUMBER	92-411467/50
XRPX	N92-313882
TITLE	Sec. cell battery charger - checks terminal voltage before charging to increase complete discharging chances for cancellation of memory effect, reducing forced discharging frequency NoAbstract
DERWENT CLASSES	X16
PATENT ASSIGNEE	(SHAF) SHARP KK
NUMBER OF PATENTS	1
NUMBER OF COUNTRIES	1
PATENT FAMILY	JP04308429-A 92.10.30 (9250) 10p H02J-007/04
PRIORITY	91.04.04 91JP-071470
APPLICATION DETAILS	91.04.04 91JP-071470
INT'L. PATENT CLASS.	H02J-007/04
IMAGE FILENAME	WPC8THN1.GIF

-2- (WPAT)

ACCESSION NUMBER	90-243224/32
XRPX	N90-188608
TITLE	Residual capacity detecting method of lead acid cell - detects residual duration of discharge according to estimated discharge current to realise real time detection NoAbstract Dwg 1/2
DERWENT CLASSES	S01 X16 R47
PATENT ASSIGNEE	(MATU) MATSUSHITA ELEC IND KK
NUMBER OF PATENTS	1
PATENT FAMILY	J02170372-A 90.07.02 (9032) {JP}
PRIORITY	88.12.22 88JP-324126
APPLICATION DETAILS	88.12.22 88JP-324126
INT'L. PATENT CLASS.	H01M-010/48
IMAGE FILENAME	WPA57O81.GIF

-3- (WPAT)

ACCESSION NUMBER	88-283090/40
XRPX	N88-214877
TITLE	Storage battery residual capacity monitor - has storage battery connected to load NoAbstract Dwg 2/6
DERWENT CLASSES	S01 X16 R18 R51
PATENT ASSIGNEE	(HITA) HITACHI KK; (OZAR-) OZA RHOKU CMUO KENKYSUSY; (TOEP) TOKYO ELEC POWER CO INC
NUMBER OF PATENTS	1
PATENT FAMILY	J63208773-A 88.08.30 (8840) {JP}
PRIORITY	87.02.25 87JP-040335
APPLICATION DETAILS	82.02.25 82JP-040335
INT'L. PATENT CLASS.	G01R-031/36 H02J-007/00
IMAGE FILENAME	WP862FM1.GIF

-4- (WPAT)

ACCESSION NUMBER	86-202109/31
XRPX	N86-150956
TITLE	Automatic monitoring of remaining capacity of carriage battery - detecting state from voltage to determine capability of operation NoAbstract DWg 1/1
DERWENT CLASSES	S01 R18 R51
PATENT ASSIGNEE	(TSUC) TSUBAKIMOTO CHAIN KK
NUMBER OF PATENTS	1

PATENT FAMILY J61135335-A 86.06.23 (8631) {JP}
PRIORITY 84.12.04 84JP-255090
APPLICATION DETAILS 84.12.04 84JP-255090
INT'L. PATENT CLASS. G01R-031/36 H02J-001/00

-5- (WPAT)
ACCESSION NUMBER 86-146989/23
XRPX N86-108910
TITLE Secondary battery changing unit - has timer and discharging and charging circuits for secondary battery to avoid over-charging NoAbstract Dwg 1/3
DERWENT CLASSES X16 R47 R51
PATENT ASSIGNEE (SONY) SONY CORP
NUMBER OF PATENTS 1
PATENT FAMILY J61081139-A 86.04.24 (8623) {JP}
PRIORITY 84.09.27 84JP-202183
APPLICATION DETAILS 84.09.27 84JP-202183
INT'L. PATENT CLASS. H01M-010/44 H02J-007/04

-6- (WPAT)
ACCESSION NUMBER 84-077830/13
XRPX N84-058092
TITLE Residual battery power display appts. - has resistor connected between battery and load, and accumulator detecting current flowing through resistor NoAbstract Dwg 0/3
DERWENT CLASSES S01 X16 R18 R47
PATENT ASSIGNEE (FUJF) FUJI PHOTO FILM KK
NUMBER OF PATENTS 1
PATENT FAMILY J59028678-A 84.02.15 (8413) {JP}
PRIORITY 82.08.10 82JP-137853
APPLICATION DETAILS 82.08.10 82JP-137853
INT'L. PATENT CLASS. G01R-031/36 H01M-010/48

-7- (WPAT)
ACCESSION NUMBER 83-B8802K/06 (B8802K)
XRPX N83-024474
TITLE Battery specific gravity detector - has sensors made of optical fibre arranged at different level of electrolyte, and arithmetic unit for detected signals. NoAbstract
DERWENT CLASSES S01 X16 S03 R47
PATENT ASSIGNEE (SNLE) STANLEY ELEC KK
NUMBER OF PATENTS 1
PATENT FAMILY J57210578-A 82.12.24 (8306) {JP}
PRIORITY 81.06.22 81JP-096227
INT'L. PATENT CLASS. H01M-010/48

-8- (WPAT)
ACCESSION NUMBER 82-J3187E/28 (J3187E)
TITLE Batting condition displaying device - has specific gravity detecting float, float displacement detector and temp. detector
DERWENT CLASSES X16 R47
PATENT ASSIGNEE (TOYO) TOYO KOGYO KK
NUMBER OF PATENTS 1
PATENT FAMILY J57088679-A 82.06.02 (8228) {JP}
PRIORITY 80.11.25 80JP-166421
INT'L. PATENT CLASS. H01M-010/48

-9- (JAPIO)

ACCESSION NUMBER	92-308429
TITLE	CHARGER FOR SECONDARY BATTERY
PATENT APPLICANT	(2000504) SHARP CORP
INVENTORS	KANEKO, SHIGEHIRO
PATENT NUMBER	92.10.30 J04308429, JP 04-308429
APPLICATION DETAILS	91.04.04 91JP-071470, 03-71470
SOURCE	93.03.22 SECT. E, SECTION NO. 1336; VOL. 17, NO. 140, PG. 14.
INT'L PATENT CLASS	H02J-007/04
JAPIO CLASS	42.9 (ELECTRONICS--Other)
FIXED KEYWORD CLASS	R116 (ELECTRONIC MATERIALS--Light Emitting Diodes, LED); R131 (INFORMATION PROCESSING--Microcomputers & Microprocessers)

ABSTRACT

PURPOSE: To prevent charging time for a secondary battery from being unreasonably lengthened while a memory effect of the secondary battery can be effectively eliminated and suppressed.

CONSTITUTION: In the case of mounting a secondary battery 2 to a battery terminal 9, terminal voltage of the secondary battery 2 is measured prior to charging. In the case of the terminal voltage in a fixed range in the vicinity of final voltage of the secondary battery 2, a discharge limiting switch 16 is turned on to perform a forced discharge of the secondary battery 2 prior to the charging. The charging is started first when the terminal voltage is decreased surely lower than the final voltage. In the case of the detected terminal voltage out of the above-mentioned range, the charging is instantaneously started. Since the forced discharge of the secondary battery is automatically performed at an adequate period, a memory effect is effectively eliminated and suppressed.

-10- (JAPIO)

ACCESSION NUMBER	90-170372
TITLE	RESIDUAL AMOUNT SENSING METHOD FOR LEAD STORAGE BATTERY
PATENT APPLICANT	(2000582) MATSUSHITA ELECTRIC IND CO LTD
INVENTORS	FUKUNAGA, HIDEMI; KAMAIKE, TADAYOSHI; SUGIYAMA, HIROSHI; ONODA, YUKIHIRO
PATENT NUMBER	90.07.02 J02170372, JP 02-170372
APPLICATION DETAILS	88.12.22 88JP-324126, 63-324126
SOURCE	90.09.17 SECT. E, SECTION NO. 979; VOL. 14, NO. 433, PG. 155.
INT'L PATENT CLASS	H01M-010/48
JAPIO CLASS	42.9 (ELECTRONICS--Other)
FIXED KEYWORD CLASS	R131 (INFORMATION PROCESSING--Microcomputers & Microprocessers)

ABSTRACT

PURPOSE: To have real time sensing of residual dischargeable time by measuring the discharge current, voltage, and battery temp. at certain intervals during discharging, performing integral calculation of the discharged amount, and by computing the residual duration time upon comparing with the standard discharge characteristic data.

CONSTITUTION: When power interruption is sensed by a monitoring device from a switch signal or storage battery di digital signal is transmitted

cumulator 5. The adder 5a outputs the output of the converter 4 and the output fed back from a register 5b and transmits the same to the register 5b. The register 5b reads the output of the adder 5a by the clock pulses transmitted from a clock pulse generator 6 and stores the same. Thus the output of the adder 5a indicates the time-integrated value of the current flowing in the resistance 1. A display device 7 displays the content of the register 5b.

-15- (JAPIO)

ACCESSION NUMBER	83-085179
TITLE	DETECTOR FOR RESIDUAL CAPACITY OF SECONDARY BATTERY
PATENT APPLICANT	(2000423) NEC CORP
INVENTORS	TAUCHI, OSAMU
PATENT NUMBER	83.05.21 J58085179, JP 58-85179
APPLICATION DETAILS	81.11.17 81JP-184825, 56-184825
SOURCE	83.08.13 SECT. P, SECTION NO. 216; VOL. 7, NO. 184, PG. 17.
INT'L PATENT CLASS	G01R-031/36
JAPIO CLASS	46.1 (INSTRUMENTATION--Measurement); 42.9 (ELECTRONICS--Other)

ABSTRACT

PURPOSE: To detect the residual capacity of a battery with a slight discharge rate at a desired time while scarcely affecting the residual quantity of electricity by determining the arrival of a fixed terminal voltage, the time covered until the arrival thereof and the like with a short time discharge of a large current.

CONSTITUTION: A short time timer 7 and a time counter 10 are actuated through a manual button 2 or a long time timer 6 and the like. The current discharged of a secondary battery to be measured increases in linearity with capacitors 4 and 70 similar in the property and a heavy discharge switching element 3 and the like through a constant current driver 5, which causes the discharge of a large current negligible in a short time. Consequently, the terminal voltage of a battery 1 lowers and the arrival of the reference voltage with a comparator 8 is detected to reset the timers 6 and 7. The count of the counter 10 based on the time covered until the arrival thereof corresponds to a computed value of the quantity of residual electricity in terms of ampere-hour. This enables the detection of the residual capacity of a secondary battery with a slight discharge rate at a desired time little affecting the quantity of residual electricity utilizing the characteristic of increase in the internal resistance with a decrease in the quantity of electricity storage.

-16- (JAPIO)

ACCESSION NUMBER	82-210578
TITLE	DETECTOR FOR BATTERY RESIDUAL CAPACITY
PATENT APPLICANT	(2000230) STANLEY ELECTRIC CO LTD
INVENTORS	TEJIMA, TORU; KIMURA, SHIGERU
PATENT NUMBER	82.12.24 J57210578, JP 57-210578
APPLICATION DETAILS	81.06.22 81JP-096227, 56-96227
SOURCE	83.03.15 SECT. E, SECTION NO. 164; VOL. 7, NO. 62,

PG. 151.

INT'L PATENT CLASS H01M-010/48
JAPIO CLASS 42.9 (ELECTRONICS--Other); 26.2 (TRANSPORTATION--Motor Vehicles); 43.4 (ELECTRIC POWER--Applications)
FIXED KEYWORD CLASS R012 (OPTICAL FIBERS); R116 (ELECTRONIC MATERIALS--Light Emitting Diodes, LED)

ABSTRACT PURPOSE: To obtain a detector for the battery residual capacity of a motorcar, an electric motorcar and the like, which gives an accurate measurement and the measured data can be extremely easily seen directly as a value, by placing a plural number of sensors in the electrolyte of a battery so that they are differently apart from the liquid level of the electrolyte, and indicating the average value of the specific gravities of parts of the electrolyte by detecting the said specific gravities.
CONSTITUTION: Light supplied from a light source 3 is received by a light receiving part 4 after passing through sensors S1, S2 and S3. This leads to the fact that the amount of the attenuation at the fully charged state of a battery 2, when the specific gravity of the electrolyte is high, is large. In contrast, the amount of the attenuation during the discharge of the battery 2, when the specific gravity of the electrolyte is low, is small. Light receiving parts 4a, 4b and 4c of the part 4 are given outgoing light attenuated, respectively, according to the specific gravities of parts of the electrolyte which are locations for the sensors S1, S2 and S3, and produce electric signals corresponding to the amounts of light received by the parts 4a, 4b and 4c. An arithmetic circuit 5 converts the output of the light receiving part 4 into an average output, and converts the average output into a corresponding specific gravity of the electrolyte. After that, the output of the circuit 5 is displayed on a display part 6 as the specific gravity of the electrolyte at that point.

-17- (JAPIO)
ACCESSION NUMBER 82-088679
TITLE DEVICE FOR DISPLAYING RESIDUAL CAPACITY OF BATTERY
PATENT APPLICANT (2000313) MAZDA MOTOR CORP
INVENTORS YASUNA, NAOSHI; SADAHIRA, SEIJI
PATENT NUMBER 82.06.02 J57088679, JP 57-88679
APPLICATION DETAILS 80.11.25 80JP-166421, 55-166421
SOURCE 82.09.03 SECT. E, SECTION NO. 128; VOL. 6, NO. 170, PG. 153.
INT'L PATENT CLASS H01M-010/48
JAPIO CLASS 42.9 (ELECTRONICS--Other); 26.2 (TRANSPORTATION--Motor Vehicles); 43.4 (ELECTRIC POWER--Applications)

ABSTRACT PURPOSE: To enhance the detection accuracy of the residual capacity of a battery by performing corrections on changes in both the liquid level and the temperature of battery liquid, and electrically detecting the specific gravity, the liquid level decrease and the temperature of the battery liquid.
CONSTITUTION: The residual capacity of a battery is displayed through the detection of the specific

gravity of battery liquid. The former detection is carried out by changing the up-and-down movement of a metal piece or the like, which is installed in a specific-gravity detection float, electrically into a float displacement signal by means of a float displacement detecting circuit 7 consisting of a search coil 1e and the like. The liquid level of the battery liquid is taken out as a liquid-level displacement signal by means of the float, a search coil 5e and a liquid-level detecting circuit 8. The temperature of the battery liquid is electrically taken out by means of a liquid-temperature detecting circuit 10 consisting of a thermistor 6b and the like. The float displacement signal obtained through the detection of the specific gravity undergoes a correction 9 carried out according to the liquid-level displacement signal, and is subjected to a temperature correction 11 carried out according to a siganl sent from the circuit 10. Therfore, the residual capacity given on the basis of the accurate detection of the specific gravity of the battery liquid is displayed on a meter 12 or the like.

-18- (JAPIO)

ACCESSION NUMBER	81-026271
TITLE	MEASURING DEVICE FOR RESIDUAL QUANTITY OF ELECTRICITY OF SECONDARY BATTERY
PATENT APPLICANT	(2000423) NEC CORP
INVENTORS	TAKADA, ISAMU
PATENT NUMBER	81.03.13 J56026271, JP 56-26271
APPLICATION DETAILS	79.08.08 79JP-101442, 54-101442
SOURCE	81.05.27 SECT. P, SECTION NO. 63; VOL. 5, NO. 81, PG. 14.
INT'L PATENT CLASS	G01R-031/36
JAPIO CLASS	46.1 (INSTRUMENTATION--Measurement); 42.9 (ELECTRONICS--Other)

ABSTRACT

PURPOSE: To ensure a high-accuracy measrement for the residual quantity of electricity of the secondary battery, by inserting the current detection element into the charge/discharge path to amplify the detection signal and then connecting the electrolytic electricity meter to the amplifying circuit. CONSTITUTION: For instance, the charging current delivered from charger 10 during the charging passes through current detection element 12 via contact 11a of charge/ discharge switch 11 and then sent to secondary battery 13 for charging. The charging current is detected at the side of 12a by element 12, and this output is amplified through current amplifier 14 into the sufficient current to actuate electrolytic coulombmeter 18. In correspondence to 12a, 18a is supplied in the positive polarity to meter 18, and then the deposition is started by the electrolysis. In this instant, the gain of amplifier 14 is controlled via gain setting adjuster 16 in consideration of the charging efficiency according to the type of the secondary battery. In such way, the residual quantity of electriciy can be measured for the secondary battery with a small loss and a high accuracy.

-19- (JAPIO)

ACCESSION NUMBER	81-024678
TITLE	PATTERN MATCHING DEVICE
PATENT APPLICANT	(2000423) NEC CORP
INVENTORS	SEKOE, HIROAKI
PATENT NUMBER	81.03.09 J56024678, JP 56-24678
APPLICATION DETAILS	79.08.06 79JP-100560, 54-100560
SOURCE	81.05.21 SECT. P, SECTION NO. 62; VOL. 5, NO. 77, PG. 107.
INT'L PATENT CLASS	G06K-009/62
JAPIO CLASS	45.3 (INFORMATION PROCESSING--Input Output Units)
FIXED KEYWORD CLASS	R108 (INFORMATION PROCESSING--Speech Recognition & Synthesis)

ABSTRACT

PURPOSE: To compute the distance between the portion pattern of the time system row of the input pattern and the standard pattern and attain the low cost by constructing by the standard pattern memory portion, the input pattern buffer, the distance calculating portion, the distance buffer and the gradual type calculating portion.

CONSTITUTION: The standard pattern memory portion 110 becomes the memory constituting the sector and in the n-th sector, the standard pattern B(sup n) is stored by a form of the formula I. The vector ai is fed from the input pattern buffer 120, and the vector bj fed from the standard pattern memory portion 110, respectively toward the distance calculating portion 130. In the calculating portion 130, the distance d(i,j) of these vectors ai, bj is computed and as the signal (c), fed to the distance buffer 140. With reference to the distance d(i,j) stored in the distance buffer 140, the gradual type computing portion 150 performs the gradual type computation from the formula II to the formula IV is performed. That is, the distance D between the partial pattern A(p,m) in the time system of the input pattern ai and the standard pattern B(sup n) is computed.

-20- (JAPIO)

ACCESSION NUMBER	77-032542
TITLE	STORAGE BATTERY CHARGE INDICATING CIRCUIT
PATENT APPLICANT	(2000732) GENERAL ELECTRIC CO
INVENTORS	KONRATSUDO, CHIYAARUZU EDOWAADO
PATENT NUMBER	77.03.11 J52032542, JP 52-32542
APPLICATION DETAILS	76.08.19 76JP-098272, 51-98272
PRIORITY	75.08.21 75US-606615, US 606615
INT'L PATENT CLASS	H02J-007/00
JAPANESE PATENT CLASS	57D1
JAPIO CLASS	42.9 (ELECTRONICS--Other); 26.2 (TRANSPORTATION--Motor Vehicles); 43.4 (ELECTRIC POWER--Applications)

SS 3?

-1- (JAPIO)

ACCESSION NUMBER	91-163375
TITLE	RESIDUAL CAPACITY DISPLAY SYSTEM OF SECONDARY BATTERY
PATENT APPLICANT	(2358923) KYOCERA CORP
INVENTORS	TEZUKA, HIROBUMI; WATARI, SHINICHIRO; SHIRAI, TETSUYUKI
PATENT NUMBER	91.07.15 J03163375, JP 03-163375
APPLICATION DETAILS	89.11.22 89JP-303497, 01-303497
SOURCE	91.10.16 SECT. P, SECTION NO. 1263; VOL. 15, NO. 406, PG. 4.
INT'L PATENT CLASS	G01R-031/36
JAPIO CLASS	46.1 (INSTRUMENTATION--Measurement); 26.2 (TRANSPORTATION--Motor Vehicles); 42.9 (ELECTRONICS--Other)

ABSTRACT

PURPOSE: To always accurately display residual capacity and to adapt a residual capacity display system to various secondary batteries by measuring the internal resistance of a secondary battery at an arbitrary period and storing the result obtained on the basis of said resistance as the residual capacity used in the operation of the next time.

CONSTITUTION: When the use of load is not detected by a load use detection part 4, the internal resistance of a secondary battery 1 is measured at the arbitrary period set by a manual switch 6 or at the predetermined period preset by a timer 5 by an internal resistance measuring part 3. After measurement, the residual capacity value of the battery 1 is obtained by a comparing part 8. That is, a residual capacity value R1 is guided on the basis of the map connecting the internal resistance stored in a memory part 9 with residual capacity. Next, when the use of the load is detected, the input/output current of the battery 1 is measured by an integrated current quantity measuring part 2. V-F conversion is performed corresponding to the output of the current detection circuit provided in the measuring part 2 and the obtained pulse is counted to obtain the integrated quantity per a definite time of pulses. Next, the use quantity U per a definite time of the battery 1 is subtracted from the operation result RO of the previous time by the operation part 7 to calculate a new residual capacity value R1.

SS 4?

5229704

1. 5,422,197, Jun. 6, 1995, Electrochemical energy storage and power delivery process utilizing iron-sulfur couple; Ralph Zito, 429/51, **61**, 90, 188, 199 [IMAGE AVAILABLE]

US PAT NO: 5,422,197 [IMAGE AVAILABLE] L5: 1 of 15

ABSTRACT:
An electrochemical process for energy storage and power generation comprises a single cell or an array of unit cells (10), each cell comprising a positive electrode (12) and a negative electrode (14) with a membrane in each cell dividing it into positive and negative chambers (22C and 24C) for posilyte and anolyte solutions (22, 24) which are recirculated through separate pumps (26, 28) and storage tanks (32, 34) and back to the chambers. An iron-sulfur couple is employed, the overall reaction being:

2Fe.sup.3+ +S.sup.2- =2Fe .sup.2+ +S eq. 8

the Fe.sup.3+ ions being provided as the chloride, bromide or iodide and the sulfide being provided as the sodium, potassium, lithium or ammonium salts. The +.sup.ve chamber contains a soluble ionic salt which acts as a **charge** carrier during energy storage, preferably sodium or potassium chloride. A pH **control** system can be provided to offset pH in the system, and further a third chamber (23C) can be provided whereby the system is more effectively electrically **rechargeable**.

2. 5,415,949, May 16, 1995, Metal-air cell and power system using metal-air cells; Gordon R. Stone, et al., 429/63, 22, 23, 24, 25, 27, 28, **61**, 62, 64, 70 [IMAGE AVAILABLE]

US PAT NO: 5,415,949 [IMAGE AVAILABLE] L5: 2 of 15

ABSTRACT:
A metal air cell comprising a flexible, recloseable, pouch made of a gas-permeable, electrolyte-impermeable, material forming the cathode of the cell, a metal plate anode in the pouch, and spacers physically isolating the anode from the interior of the flexible pouch cathode, the spacers separating the anode and the cathode by a predetermined spacing. A plurality of such cells are preferably stacked into a multicell **battery**, and compressed in a harness to maintain proper anode-cathode spacing as the anode is consumed. The stack can be incorporated as a replaceable part of a larger power system including a circulatory system for circulating an electrolyte solution through the cells in the stack. A **controller** controls the circulatory system, particularly during start-up and shut-down, to achieve a fast start up, and an efficient shut down.

3. 5,362,576, Nov. 8, 1994, Current-activated bypass switch; Thomas Clark, et al., 429/7, **61**, 62 [IMAGE AVAILABLE]

US PAT NO: 5,362,576 [IMAGE AVAILABLE] L5: 3 of 15

ABSTRACT:
A switch is operated by an electrical current to automatically change from a ready condition to a tripped condition. The switch includes a fixed cylindrical contact and a movable plunger contact that are held apart by a thermal holding link acting against the force of a spring. When the switch in the ready condition, an electrical current of

sufficient magnitude passing through the thermal holding link will weaken and separate the link and thereby allow the spring to move the plunger contact into electrical contact with the cylindrical contact. In an alternative embodiment, the switch can be configured to be closed in the ready condition, in which case current does flow through the cylindrical contact and the plunger contact, but ceases when the switch is changed to the tripped condition.

4. 5,336,568, Aug. 9, 1994, Device for optimizing the **discharge** of a least two electrochemical cells; Xavier Andrieu, 429/7; 320/19; **429/61** [IMAGE AVAILABLE]

US PAT NO: 5,336,568 [IMAGE AVAILABLE] L5: 4 of 15

ABSTRACT:

The device for discharging electrochemical cells (20, 21) into a load (Rc) is of the type comprising switching means (25, 26), each cooperating with one of the electrochemical cells (20, 21), these switching means (25, 26) being controlled sequentially by a generator (23) providing N pulse trains (SC1, SC2) offset relative to one another, each electrochemical cell (20, 21) being connected to the load (Rc) for the duration of a pulse, through the switching means (25, 25) with which the cell cooperates. According to the invention, it is characterized in that the pulses of each train (SC1, SC2) have an interval of overlap with the pulses of another train (SC1, SC2), such that the load (Rc) is constantly supplied by at least one of the N electro-chemical cells (20, 21), the overlap interval being very much smaller than the duration of each of said pulses.

5. 5,264,301, Nov. 23, 1993, Metal oxide-hydrogen **battery** incorporating a mechanism for maintaining a constant pressure in the **battery**; John F. Sindorf, et al., 429/53, 58, **61**, 101 [IMAGE AVAILABLE]

US PAT NO: 5,264,301 [IMAGE AVAILABLE] L5: 5 of 15

ABSTRACT:
A metal oxide-hydrogen **battery** incorporating a system for maintaining a substantial uniform range of pressure of hydrogen gas in the **battery**. The **battery** includes an outer pressure vessel and a plurality of cells are contained in the vessel. A liquid electrolyte is impregnated within the cells and the **battery** is charged with hydrogen gas. A conduit connects the interior of the vessel with a venting zone, preferably a closed chamber, containing a hydrogen absorbing material. A first valve is located in the conduit and is designed to open when the **battery** is discharged to a preselected level. A second pressure regulated valve is also mounted in the conduit and opens to vent hydrogen from the vessel to the chamber, if the hydrogen pressure exceeds a predetermined value at the preselected state of **discharge**. The sequential venting of hydrogen during cycling of the **battery** will maintain the pressure of hydrogen in the vessel within a given range.

6. 5,258,239, Nov. 2, 1993, Metal-air cell having a piezoelectric air-supply pump; Kazuo Kobayashi, 429/27, **61**, 90 [IMAGE AVAILABLE]

US PAT NO: 5,258,239 [IMAGE AVAILABLE] L5: 6 of 15

ABSTRACT:·
The present invention relates to a metal-air cell having a piezo-electric pump. The piezo-electric pump has a characteristic of moderate change of air flow speed relative to the pressure. Accordingly, the air supply speed can be controlled easily. This characteristic enables small and simple construction of the metal-air cell with the maximum electrical energy being obtained from the cell.

7. 5,215,834, Jun. 1, 1993, **Battery** thermal **control** system and method; Michael T. Reher, et al., 429/62, **61**, 120 [IMAGE AVAILABLE]

US PAT NO: 5,215,834 [IMAGE AVAILABLE] L5: 7 of 15

ABSTRACT:
A **battery** thermal **control** system and method is provided which selectively heats or cools a storage **battery** in accordance with the **battery** temperature and state of **charge**. The thermal **control** system includes a **battery** housing having an internal airspace between the **battery** and the housing which extends between two openings in the **battery** housing, a reversible fan configured to generate an airstream along the airspace, a temperature sensor mounted to detect the temperature of the **battery**, and a **control** circuit for monitoring **battery** temperature and voltage and for controlling the operation of the fan. **Battery** state of **charge** is approximated by measuring **battery** voltage and monitored to prevent excessive **battery** **discharge** by the thermal **control** system. When the **battery** voltage exceeds a predetermined voltage and the **battery** temperature is outside of a predetermined range of suitable operating and storage temperatures, the thermal **control** system operates the fan to heat or cool the **battery**, as needed.

8. 5,061,578, Oct. 29, 1991, Electrolyte circulation type **secondary** **battery** operating method; Ichiro Kozuma, et al., 429/3; 136/291; 429/51, **61** [IMAGE AVAILABLE]

US PAT NO: 5,061,578 [IMAGE AVAILABLE] L5: 8 of 15

ABSTRACT:
A method of operating a **secondary** **battery** including a stack of **secondary** cells operable, in the presence of electrolytes, in a **charge** mode charging electrical power from a source of electrical power and in a **discharge** mode discharging the **charge** electrical power from the **secondary** cell. A part of the electrical power from the electrical power source is used intermittently in the **charge** mode to provide intermittent circulation of the electrolytes through the **secondary** cell. The **secondary** cell continues to operate in the **charge** mode with the electrolytes residual in the **secondary** cell after each interruption of circulation of the electrolytes. A part of the electrical power charged in the **secondary** cell is used intermittently in the **discharge** mode to provide intermittent circulation of the electrolytes through the **secondary** cell. The **secondary** cell continues to operate in the **discharge** mode with the electrolyes residual in the **secondary** cell after each interruption of circulation of the electrolytes.

9. 5,028,499, Jul. 2, 1991, **Charge** balancing of **rechargeable** **batteries**; Leonard J. Pearce, et al., **429/61**, 91 [IMAGE AVAILABLE]

US PAT NO: 5,028,499 [IMAGE AVAILABLE] L5: 9 of 15

ABSTRACT:

The invention relates to **charge** balancing of cells of **rechargeable** **batteries**. The **battery** comprises means to balance the distribution of hydrogen between all of the cells and means to remove the hydrogen from the cells. The **battery** further includes means to monitor the **charge** of each cell to detect if the **charge** of a cell becomes out of balance with the other cells. Hydrogen is added to the cells when the charges are out of balance to obtain self-**discharge**.

10. 4,327,157, Apr. 27, 1982, Stabilized nickel-zinc **battery**; Albert Himy, et al., **429/61**, 53, 223, 229, 248, 254 [IMAGE AVAILABLE]

US PAT NO: 4,327,157 [IMAGE AVAILABLE] L5: 10 of 15

ABSTRACT:
An alkaline nickel-zinc cell which has
(1) a nickel-nickel hydroxide cathode;
(2) a zinc-zinc oxide anode containing
(a) a corrosion inhibitor such as PbO, SnO.sub.2, Tl.sub.2 O.sub.3, In(OHub.3, or mixtures thereof;
(b) a slight corrosion accelerator such as CdO, Bi.sub.2 O.sub.3, Ga.sub.2 O.sub.3, or mixtures thereof; and
(c) a zinc active material;
(3) a mass-transport separator;
(4) an alkaline electrolyte; and
(5) means for charging the cell with an interrupted current having a frequency of from more than zero to 16 Hertz with a rest period of not less than 60 milliseconds.
Another desirable feature is the use of a pressure-cutoff switch to terminate charging when the internal pressure of the cell reaches a selected value in the range of from 5 to 8 psig.

11. 4,289,836, Sep. 15, 1981, **Rechargeable** electric **battery** system; Jerome H. Lemelson, **429/61**, 93 [IMAGE AVAILABLE]

US PAT NO: 4,289,836 [IMAGE AVAILABLE] L5: 11 of 15

ABSTRACT:
A rechargable **battery**, system and method for controlling its operation and the recharging thereof in order to prolong the useful life of the **battery** and to optimize its operation. In one form, an electronic microprocessor is provided within or attached to the **battery** for receiving and processing electrical signals generated by one or more sensors of **battery** operational variable and for generating output signals which may be employed to **control** the **charge** of the **battery** and to display one or more variables concerned with the **battery** operation.

12. 4,287,267, Sep. 1, 1981, Zinc-chlorine **battery** plant system and method; Curtis C. Whittlesey, et al., 429/49, **61**, 90, 122, 158 [IMAGE AVAILABLE]

US PAT NO: 4,287,267 [IMAGE AVAILABLE] L5: 12 of 15

ABSTRACT:
A zinc-chlorine **battery** plant system and method of redirecting the electrical current around a failed **battery** module. The **battery** plant includes a power conditioning unit, a plurality of **battery** modules connected electrically in series to form **battery** strings, a plurality of **battery** strings electrically connected in parallel to the power conditioning unit, and a bypass switch for each **battery** module in the **battery** plant. The bypass switch includes a normally open main contact across the power terminals of the **battery** module, and a set of normally closed auxiliary contacts for controlling the supply of reactants electrochemically transformed in the cells of the **battery** module. Upon the determination of a failure condition, the bypass switch for the failed **battery** module is energized to close the main contact and open the auxiliary contacts. Within a short time, the electrical current through the **battery** module will substantially decrease due to the cutoff of the supply of reactants, and the electrical current flow through the **battery** string will be redirected through the main contact of the bypass switch.

13. 3,977,906, Aug. 31, 1976, Flat alkaline cell with positive and negative terminal connections and a third terminal connection for an auxiliary electrode; Theodore R. Beatty, et al., 429/185, 59, **61**, 90 [IMAGE AVAILABLE]

US PAT NO: 3,977,906 [IMAGE AVAILABLE] L5: 13 of 15

ABSTRACT:
A flat alkaline cell is described wherein an electrode assembly including at least a pair of flat electrode elements of opposite polarity having a porous separator containing an alkaline electrolyte interposed therebetween and a current collector disposed adjacent to and in electrical connection with one of the pair of electrode elements at one end of the electrode assembly, are enclosed within a sealed, liquid impervious plastic film envelope having an opening in one wall thereof which exposes at least a portion of the current collector for making external electrical connection therewith, and wherein a layer of an adhesive sealant which is non-wettable by the alkaline electrolyte, tightly adheres and seals together the current collector and the wall of the envelope at least around the periphery of the opening. The exposed portion of the current collector constitutes a first terminal connection to which a wire lead or the like may be attached. A second and third terminal connection are provided in the sealed envelope, the former being in electrical connection with the other of the pair of electrode elements of opposite polarity and the latter being in electrical connection with an auxiliary electrode.

14. 3,639,173, Feb. 1, 1972, METHOD OF CONTROLLING ZINC DENDRITE GROWTH; Zbigniew Stachurski, 320/30; **429/61** [IMAGE AVAILABLE]

US PAT NO: 3,639,173 [IMAGE AVAILABLE] L5: 14 of 15

ABSTRACT:
The growth of zinc dendrites during **charge** of a silver-zinc cell is a particularly undesirable feature of the zinc electrode as it eventually leads to shorting of the cell through growth of metallic trails of zinc through the separator. A method is disclosed of preventing the growth of zinc dendrites and more particularly of preventing zinc dendrite

penetration of the separator. The method involves controlling the overpotential in the cell, i.e., limiting the overpotential to a value below the critical magnitude at which the zinc deposits as dendrites instead of as a moss. When zinc deposits as a moss, penetration of the separator does not occur. The new method involves so limiting the **charge** overpotential and using a **charge** rate that the cell is fully charged by the time the critical overpotential is reached. The overpotential is measured between the working zinc electrode and a built-in zinc reference electrode. When the critical overpotential is reached, charging is terminated.
The subject matter of the invention also includes an improved electrochemical apparatus whose efficiency and useful life derive from the prevention of zinc penetration of the separator.

15. 3,620,843, Nov. 16, 1971, **RECHARGEABLE** CELL HAVING MOVING TAPE AND ROTATING ELECTRODES; John E. Clifford, **429/61**, 219, 221, 222, 223, 225, 228, 229, 252 [IMAGE AVAILABLE]

US PAT NO: 3,620,843 [IMAGE AVAILABLE] L5: 15 of 15

ABSTRACT:
An electrically **rechargeable** cell comprising, in a charged state, an anode comprising a long steel tape coated on both sides with zinc forming the active surfaces, an aqueous electrolyte of potassium hydroxide saturated with zinc oxide and contained in and immobilized by a thin porous separator attached to each zinc surface, and two cylindrical rotatable air-permeable cathodes. The tape is driven from a storage reel to regions in contact with a substantial portion of each cylindrical cathode and onto a takeup reel, to utilize the zinc on both sides of the tape, at speeds dependent on the load current or voltage, or both. During charging, the tape is driven in the opposite direction.
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L2 12541 S L1 AND CHARG# AND DISCHARG#
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1. 5,411,537, May 2, 1995, Rechargeable biomedical **battery** powered devices with recharging and control system therefor; Mohammed Z. Munshi, et al., 607/33; **320/22**, **38**, **40** [IMAGE AVAILABLE]

US PAT NO: 5,411,537 [IMAGE AVAILABLE] L1: 1 of 21

ABSTRACT:
An improved hermetically-sealed automatic implantable cardioverter-defibrillator (AICD) or any other bioimplantable device which may be operated on a single rechargeable cell, or a dual power source system, the rechargeable component being recharged by magnetic induction. Included in the implantable devices are new lithium rechargeable chemistries designed to sense the state-of-charge or **discharge** of the **battery**; a **battery** charge controller specifically designed to recharge a lithium **battery** rapidly to less than 100% full charge, and preferably 90%, more preferably 80%, of full rated charge capacity; and charging means for multi-step charging. The **batteries** are based on lithium chemistries specially designed to yield higher currents than conventional primary lithium chemistries and to permit long-term performance despite sub-capacity recharging.

2. 5,349,282, Sep. 20, 1994, **Battery** charging and monitoring system; Malcolm S. McClure, **320/32**, **40**, **48** [IMAGE AVAILABLE]

US PAT NO: 5,349,282 [IMAGE AVAILABLE] L1: 2 of 21

ABSTRACT:
This invention relates to the use of rechargeable **batteries** for supply of electrical power. Devices are provided which are highly efficient and which provide accurate and reliable control and indications, while using a small number of component parts and being otherwise readily and economically manufacturable. Devices of the invention are compact and such that they can be readily included, if desired, as integral parts of **battery** packs such as those used for supplying power to lap-computers and other types of portable equipment.

3. 5,208,526, May 4, 1993, Electrical power storage apparatus; Arnold J. Goldman, et al., **320/2**, **15**; 429/15, 27 [IMAGE AVAILABLE]

US PAT NO: 5,208,526 [IMAGE AVAILABLE] L1: 3 of 21

ABSTRACT:
A rechargeable, electrical power storage system employing an electrical power storage medium in the form of a slurry containing active metal particles and an electrolyte solution, which system includes one or more metal-air cells, each including outer electrode apparatus including air electrode apparatus and being configured to define a liquid permeable housing; a volume of the active metal particles arranged within the housing so as to define a static bed which is saturated with the electrolyte solution; inner electrode apparatus arranged within the housing so as to be surrounded by the static bed. The system also includes apparatus for circulating an electrolyte solution through the static bed so as to dissolve **discharge** products that form therein as

the slurry becomes electrically **discharged**, and apparatus for removing the dissolved **discharge** products from the circulating electrolyte. The electrical power storage system may be used for powering an electric vehicle. An electrical energy system includes an electric utility having electricity generation apparatus and distribution lines, and rechargeable electrical power storage apparatus which provides energy to the electric utility, when required. The rechargeable electrical power storage apparatus may optionally also be used for the regeneration of slurry for replacement of electrically **discharged** slurry in the electrical power storage system of an electric vehicle.

4. 5,173,652, Dec. 22, 1992, **Battery** chargers for secondary cells of **batteries**, which control the thermo response of the charge acceptor; John R. Henkel, **320/2**, **3**, **6** [IMAGE AVAILABLE]

US PAT NO: 5,173,652 [IMAGE AVAILABLE] L1: 4 of 21

ABSTRACT:
A **battery** charging system has an effective pure DC power source charging at least one secondary charge acceptor utilizing an aqueous electrolyte. The applied effective voltage is equal to or slightly greater than the full charge level of said acceptor cell. An impedance/resistance is coupled between the power source and the secondary charge acceptor cell. The impedance/resistance is a value which reduces any AC component out of the secondary cell to no more than 5% of the total voltage out in order to reduce the counterelectromotive force responsive to the applied voltage. The impedance/resistance has a value which is selected to set the capacitive reactance of the acceptor cell and the inductance reactance of the power source at levels which reduce the counterelectromotive force of the acceptor cell throughout the full charge cycle in order to produce a cooling effect.

5. 5,159,258, Oct. 27, 1992, Rechargeable **battery** conditioner unit; Albert Kolvites, et al., **320/14**, **2** [IMAGE AVAILABLE]

US PAT NO: 5,159,258 [IMAGE AVAILABLE] L1: 5 of 21

ABSTRACT:
A piggyback conditioner unit usable in conjunction with a Ni-Cad **battery** power pack and a standard charger for the pack, the pack being normally adapted to be seated on and connected to the charger for recharging. The power pack is subject to a "memory effect" that decreases its ability to regain its rated energy capacity unless before being recharged, it is first **discharged** from its existing state of **discharge** to a deep **discharge** state. When put to use, the **battery** conditioner unit is physically and electrically interposed between the charger and the power pack to create an assembly in which the unit is seated on and electrically connected to the charger, and the pack is seated on and electrically connected to the unit. The unit includes means to further **discharge** the power pack seated thereon until a deep **discharge** state is reached, which condition is reflected in a reduced pack voltage that is sensed to automatically activate the charger which then proceeds to recharge the pack. When the pack is recharged to its full rated capacity, this condition is sensed by the charger which then switches to a low-current maintenance charge state. The resultant drop in charger voltage is sensed by the unit and indicated to inform the user that the pack is now fully recharged and in condition for reuse.

6. 5,153,496, Oct. 6, 1992, Cell monitor and control unit for multicell **battery**; David H. LaForge, **320/17**, **13**, **18** [IMAGE AVAILABLE]

US PAT NO: 5,153,496 [IMAGE AVAILABLE] L1: 6 of 21

ABSTRACT:
A cell monitoring and control circuit for a multicell **battery** comprises a cell access switch coupled to the cells of the **battery** for electronically accessing individual cells of the **battery** and a monitoring and control circuit coupled to the cell access switch for electronic communication with the cells. The circuit is coupled to the **battery** for providing electric power and constitutes an insignificant current drain on the **battery**. The circuit senses the voltage state of each cell and controls the charging of each cell and provides End-of-**Discharge** and End-of-Charge signals.

7. 5,121,044, Jun. 9, 1992, Electrical energy system; Arnold J. Goldman, **320/2**; 307/66; 429/21 [IMAGE AVAILABLE]

US PAT NO: 5,121,044 [IMAGE AVAILABLE] L1: 7 of 21

ABSTRACT:
An electrical energy system including an electric utility having an electricity generating apparatus and distribution lines, a plurality of electric vehicles and electric power storage apparatus receiving electrical power from the electric utility and supplying electrical power to the plurality of electric vehicles and to the electric utility when required.

8. 4,829,225, May 9, 1989, Rapid **battery** charger, **discharger** and conditioner; Yury Podrazhansky, et al., **320/14**, **20**, **21** [IMAGE AVAILABLE]

US PAT NO: 4,829,225 [IMAGE AVAILABLE] L1: 8 of 21

ABSTRACT:
An improved method and device for rapidly charging a **battery** by providing a charge pulse to the **battery**, followed immediately by a depolarization pulse created by allowing the **battery** to **discharge** across a load, followed by a stabilization period, and repeating this sequence cyclically until the **battery** is charged is disclosed. Preferably, the current level of the charge pulse is equal to or greater than the nominal rated current at which the **battery** can **discharge** in an hour, in order to achieve rapid charging. The duration of the charge pulse will generally be about one-tenth to two seconds. The current level of the depolarization pulse may be approximately the same magnitude or greater than the charging current, but of significantly shorter duration, such as 0.2-5% of the duration, to avoid unnecessary **discharging** of the **battery**. The duration of the stabilization period is generally greater than the magnitude of the depolarizing pulse. By optimizing these time and current characteristics of the charge, depolarization and stabilization periods for any particular type of **battery**, the **battery** may be charged most rapidly while prolonging the life of the **battery**. These characteristics may also be varied as the **battery** is charged based on the charge of the **battery** measured under load.

9. 4,742,289, May 3, 1988, Method for the cyclical trickle charging of a chargeable **battery** intended for emergency operation; Tommy Wahlstrom, **320/14**, **22**, **31**, **37**, **39** [IMAGE AVAILABLE]

US PAT NO: 4,742,289 [IMAGE AVAILABLE] L1: 9 of 21

ABSTRACT:

The present invention relates to a method for the cyclical trickle charging of a chargeable **battery** intended for emergency operation. The charging voltage used for this purpose is the output voltage from a source of d.c. voltage providing a variable level of output voltage. A characteristic feature of the invention is the fact that charging from a starting mode (1) is executed in accordance with a cyclical charging program (10) which is repeated until the **battery** has been found to be fully charged. A rest mode (13) then occurs during which the **battery** is not charged, but the **battery** voltage is measured continuously. The rest mode (13) is interrupted immediately, and the aforementioned charging program (10) is re-started if it is noted in the course of measuring the voltage that the **battery** voltage has dropped below a first pre-determined value. Once the rest mode (13) has lasted for a pre-determined period, a **discharging** phase (17) will be initiated which involves the **battery** being **discharged** in accordance with a **discharging** program during which the **battery** voltage is measured continuously. The **discharging** phase (17) is interrupted if it is noted in the course of measuring the voltage that the **battery** voltage has dropped below a second pre-determined value. Once the **discharging** phase (17) has been interrupted or completed, the charging program (10) is re-started.

10. 4,734,635, Mar. 29, 1988, Microprocessor controlled **battery** **reconditioner** for portable radio transceivers; David J. Theobald, **320/13**; 455/90 [IMAGE AVAILABLE]

US PAT NO: 4,734,635 [IMAGE AVAILABLE] L1: 10 of 21

ABSTRACT:
Unique **battery** **reconditioning** circuitry is described that may be advantageously utilized in a portable radio transceiver (100). **Reconditioning** is initiated by a microcomputer (120) in response to a pre-selected key sequence entered by way of a keyboard (114). The microcomputer (120) turns on a voltage switch (136) to deep **discharge** a Ni-Cad **battery** (118) and uses a voltage detector (140) to monitor the voltage Vb of the **battery** (118). The **battery** (118) is **discharged** from a nominal 7.5 V to 6 V in approximately two hours. The **battery** voltage Vb is converted to a digital value by the voltage detector (140). During the **reconditioning** process, the microcomputer (120) compares the digital value of the **battery** voltage Vb to a stored predetermined value to determine that the **battery** (118) has been **discharged** to 6 V. Once the **battery** (118) reaches 6 V, the **reconditioning** process is terminated and the portable radio transceiver (100) is turned off. The **battery** **reconditioning** circuitry of the present invention may be advantageously utilized in a variety of applications where portable equipment is operated from rechargeable **batteries**.

11. 4,691,158, Sep. 1, 1987, Method of operating a secondary **battery** to **recondition** the **battery**; Takafumi Hashimoto, et al.,

320/14, **4**, **26** [IMAGE AVAILABLE]

US PAT NO: 4,691,158 [IMAGE AVAILABLE] L1: 11 of 21

ABSTRACT:
A secondary **battery** operating method for charging and **discharging** a secondary **battery** using zinc as the negative electrode active material. After the termination of the normal **discharge**, direct current supply means is connected to the secondary **battery** in opposite polarity relation with each other and the secondary **battery** is reverse charged in a polarity opposite to the normal polarity. As a result of this reversed charge, the zinc remaining on the negative electrode after the termination of the normal **discharge** is completely dissolved into the electrolyte. If necessary, the energy stored in the secondary **battery** after the termination of the normal **discharge** is regenerated during the reversed charge.

12. 4,575,679, Mar. 11, 1986, Automatic load shed control for spacecraft power system; Albert S. Chung, et al., 324/427; 307/39; **320/40**, **48**; 323/906 [IMAGE AVAILABLE]

US PAT NO: 4,575,679 [IMAGE AVAILABLE] L1: 12 of 21

ABSTRACT:
An automatic load shed control for a spacecraft power system employs a selectable one of a plurality of charging gains to approximate a state of charge in a secondary **battery** system. An ampere hour meter is initialized when the **battery** system is known to be fully charged and the inefficiencies of the charging system are lumped into a charging gain parameter. An output of the ampere hour meter is compared with a load shed threshold to determine the time for load shedding. The charging gain can be remotely changed as required to a value which causes the output of the ampere hour meter to track the true state of charge of the **battery** system closely enough for system satisfactory operation of load shedding. The charging gain may be a constant or may be a variable in dependence on the state of charge of the **battery** system. Charge which is delivered at a rate below a predetermined threshold is ignored by the ampere hour meter.

13. 4,575,669, Mar. 11, 1986, **Battery** equalizer circuit; Harry B. Brown, **320/13**, **14**, **29**, **39** [IMAGE AVAILABLE]

US PAT NO: 4,575,669 [IMAGE AVAILABLE] L1: 13 of 21

ABSTRACT:
A **discharge** circuit reduces the state of charge of a **battery** to a nominal zero so that the **battery** can be put through one or more complete charge/**discharge** cycles.

14. 4,517,517, May 14, 1985, Nickel-cadmium **battery** conditioner and tester apparatus; Daniel C. Kinney, 324/433; **320/48**; 324/436 [IMAGE AVAILABLE]

US PAT NO: 4,517,517 [IMAGE AVAILABLE] L1: 14 of 21

ABSTRACT:
A **battery** tester apparatus having a **discharge** circuit with a visual indicator that the **discharge** cycle is in progress operating in

combination with a comparator to determine when the terminal voltage of the **battery** is reached. At this point the comparator provides a signal to an oscillator which in turn controls an SCR diode switch that terminates the **discharge** cycle.

15. 4,331,911, May 25, 1982, Method of equalizing the voltages of the individual cells of storage **batteries**; Robert H. Park, **320/14**, **17**, **39** [IMAGE AVAILABLE]

US PAT NO: 4,331,911 [IMAGE AVAILABLE] L1: 15 of 21

ABSTRACT:
There is disclosed a method of equalizing the voltages of the individual cells of a storage **battery** that consists in the steps of,

1. providing a single input circuit type of d.c. to d.c. converter incorporating multiple output circuits equal in number to the number of cells of the **battery** to which it is planned that the converter will make connection, with the converter so designed and employed that, with its input circuit connected to the terminals of the **battery**, and one of each of its output circuits connected across one of each of the cells of the **battery**, flow of cell equalizing current will hold low so long as the downward departures of the voltages of the **battery**'s cells from average cell voltage hold below a prescribed index value.
2. providing, via method of converter design and employment, and choice of the above referred to index value, so that, for a given type, size, and prior condition of use of a **battery**, employment of the converter as in step 1 above can be expected to provide a cost-effective way to both favorably affect the equality of the **battery**'s cell voltages, and avoid cell voltage reversal during **battery** **discharge** under contemplated conditions of the **battery**'s use.
3. providing to connect one of each of the output circuits of the converter across one of each of the individual cells of the **battery**.
4. providing so that when the **battery** is in active use the input circuit of the converter will be energized from the **battery**'s terminals.
5. providing a means of indicating when the extent of inequality of the cell voltages of the **battery** is such as to cause converter input current to exceed a preset value.

16. 4,313,080, Jan. 26, 1982, Method of charge control for vehicle hybrid drive **batteries**; Robert H. Park, **320/61**; 180/65.2; 290/16, 50 [IMAGE AVAILABLE]

US PAT NO: 4,313,080 [IMAGE AVAILABLE] L1: 16 of 21

ABSTRACT:
A method for controlling the charging of fast **discharge** and recharge type propulsion **battery** components of engine-electric hybrid drive systems for road vehicles, wherein the control objectives are to, minimize **discharge** of gas through **battery** cell vents, minimize fuel use, allow employment of a small **battery**, and provide for long **discharge**-recharge cycle life, and the control method consists in the steps of,

1--providing so that, if not earlier terminated as a result of operator termination of braking, or a drop in vehicle speed, termination of regenerative braking will be initiated at a point in time determined by

a control system generated indication of state of charge just prior to initiation of braking, and the subsequent history of cell current,

2--providing so that, following a partial **battery** **discharge**, when and as motor speed allows, supplementary engine implemented **battery** charging will take place prior to the next advent of regenerative braking, with charge termination made responsive to attainment of a **battery** voltage per series connected cell that is determined by a control system generated indication of state of charge following **discharge**,

3--providing to temporarily revert to non-hybrid, engine implemented drive, when cell voltage on **battery** deep **discharge** falls below a value that depends in a predetermined way on cell current,

4--when and as service use conditions so warrant, providing to effect increase in **battery** temperature with use of heat supplied by the engine exhaust, and providing, additionally, to temporarily revert to non-hybrid, engine implemented drive, when, and for so long a period as **battery** cell internal temperature holds below a predetermined value.

17. 4,198,594, Apr. 15, 1980, Method of charging a vented alkaline electrolyte-containing electrochemical cell; Harvey N. Seiger, et al., **320/43**, **39**, **46** [IMAGE AVAILABLE]

US PAT NO: 4,198,594 [IMAGE AVAILABLE] L1: 17 of 21

ABSTRACT:

The improved method of the present invention comprises charging a vented alkaline electrolyte-containing electrochemical cell employing an electrode pair selected from the group consisting of nickel-zinc, nickel-cadmium, silver-zinc and silver-cadmium and at least periodic measuring the charging efficiency of the cell by determining the rate of gas evolution from the cell. The charging of the cell is terminated when the charging efficiency substantially decreases, signifying the cell having reached an about full charge. The charging efficiency at that point normally substantially decreases to a value of about 0.5.+-.0.2. In the alkaline electrolyte-containing cells, the charging efficiency is determined according to the formula E=1-(15.8/I) v wherein E is the charging efficiency, I is the current in amperes and v is the gas generation rate in the cell in cc per second. The improved method prevents overcharging of the cell and accurately determines when an about full charge is reached. Accordingly, charging can be carried out without risk of damage to the cell and with the greatest efficiency.

18. 4,084,124, Apr. 11, 1978, Method and apparatus for conditioning of nickel-cadmium **batteries**; Robert E. Kapustka, **320/9**, **13**, **15**, **32**, **39** [IMAGE AVAILABLE]

US PAT NO: 4,084,124 [IMAGE AVAILABLE] L1: 18 of 21

ABSTRACT:

A method and apparatus for **reconditioning** **batteries** utilizing a DC-DC converter. During a **discharge** of the **batteries**, each cell is monitored by the converter. When the voltage of a cell decreases to a predetermined level, a converter will assume the load of this cell and inhibit the voltage from reaching zero, thereby preventing voltage reversal of that cell.

19. 3,997,830, Dec. 14, 1976, Satellite **battery** **reconditioning** system and method; Richard Abbott Newell, et al., **320/5**, **14**, **22**, **35**, **39** [IMAGE AVAILABLE]

US PAT NO: 3,997,830 [IMAGE AVAILABLE] L1: 19 of 21

ABSTRACT:
Reduction of **battery** effectiveness due to memory effect and unequal cell voltages is minimized by a spacecraft power control system which **reconditions** the **battery** preferably just prior to eclipse seasons of a geo-stationary orbit by **discharging** each **battery** cell through a network of shunting resistors. Recharging is accomplished by a low power dissipation charging sequence. The load of the system, except for during the eclipse season, is receiving power continuously from the solar cells and during peak load requirements receives supplementary power from the **battery** cells. During the eclipse seasons, the system power is supplied solely by the **battery** cells.

20. 3,696,283, Oct. 3, 1972, MODULAR **BATTERY** CHARGER; John W. Ackley, III, **320/2**, **15**, **48** [IMAGE AVAILABLE]

US PAT NO: 3,696,283 [IMAGE AVAILABLE] L1: 20 of 21

ABSTRACT:
Battery charger assembly comprising a power supply module and, detachably mated thereto and to each other, a series of charging modules capable of accommodating a varying number of cells to be charged wherein each charging module individually can accommodate cells of differing physical and electrical size, the power supply module and the charging modules together forming a parallel circuit of which each charge module forms one parallel leg.

21. 3,623,139, Nov. 23, 1971, METHOD AND APPARATUS FOR AUTOMATICALLY CONTROLLING THE FAST CHARGING OF RECHARGEABLE **BATTERIES**; Arthur F. Dickerson, **320/22**, **17**, **39** [IMAGE AVAILABLE]

US PAT NO: 3,623,139 [IMAGE AVAILABLE] L1: 21 of 21

ABSTRACT:
A method and apparatus for automatically controlling the fast recharging of a storage **battery** pack consisting of a number of cells (N). The cells are conditioned so that at least one of them is at a slightly higher charge state than the remaining cells (N-1) before initiating a recharging process. All the cells (N) are connected to a source of charging current and a voltage level responsive circuit is connected across the at least one cell which is at a higher charge state in order to monitor the increasing voltage thereof. The cells (N) are initially charged with a high current until the voltage at the terminals of the cell with the higher charge state abruptly rises and thereby signals to the voltage level responsive circuit that the cell has achieved full charge. At this point, the voltage level responsive circuit causes a transformer tap changing and switching circuit to terminate the high-current fast-charging mode and to establish a low-current slow-charging mode.
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